Scientists use world's fastest supercomputer to create the largest HIV evolutionary tree

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Mapping Darwinian evolutionary relationships results in an HIV family tree that may lead researchers to new vaccine focus areas

Los Alamos, New Mexico, October 27, 2009 — Supporting Los Alamos National Laboratory's role in the international Center for HIV/AIDS Vaccine Immunology (CHAVI) consortium, researchers are using the Roadrunner supercomputer to analyze vast quantities of genetic sequences from HIV infected people in the hope of zeroing in on possible vaccine target areas.

Physicist Tanmoy Bhattacharya and HIV researcher Bette Korber have used samples taken by CHAVI across the globe—from both chronic and acute HIV patients—and created an evolutionary genetic family tree, known as a phylogenetic tree, to look for similarities in the acute versus chronic sequences that may identify areas where vaccines would be most effective.

In this study the evolutionary history of more than 10,000 sequences from more than 400 HIV-infected individuals was compared. The idea, according to Korber, is to identify common features of the transmitted virus, and attempt to create a vaccine that enables recognition the original transmitted virus before the body's immune response causes the virus to react and mutate.

"DNA Sequencing technology, however, is currently being revolutionized, and we are at the cusp of being able to obtain more than 100,000 viral sequences from a single person," said Korber. "For this new kind data to be useful, computational advances will have to keep pace with the experimental, and the current study begins to move us into this new era.

"The petascale supercomputer gives us the capacity to look for similarities across whole populations of acute patients," said Bhattacharya. "At this scale we can begin to figure out the relationships between chronic and acute infections using statistics to determine the interconnecting branches—and it is these interconnections where a specially-designed vaccine might be most effective.

The goal of CHAVI, established by the National Institute of Allergy and Infectious diseases, is to solve major problems in HIV vaccine development and design.

About Roadrunner, the world's fastest supercomputer, first to break the petaflop barrier

On Memorial Day, May 26, 2008, the "Roadrunner" supercomputer exceeded a sustained speed of 1 petaflop/s, or 1 million billion calculations per second. &"Petaflop/s" is computer jargon—peta signifying the number 1 followed by 15 zeros (sometimes called a quadrillion) and flop/s meaning "floating point operation per second." Shortly after that it was named the world's fastest supercomputer by the TOP500 organization at the June 2008 International Supercomputing Conference in Dresden Germany.

The Roadrunner supercomputer, developed by IBM in partnership with the Laboratory and the National Nuclear Security Administration, will be used to perform advanced physics and predictive simulations in a classified mode to assure the safety, security, and reliability of the U.S. nuclear deterrent.

The system will be used by scientists at the NNSA's Los Alamos, Sandia, and Lawrence Livermore national laboratories.

The secret to its record-breaking performance is a unique hybrid design. Each compute node in this cluster consists of two AMD Opteron™ dual-core processors plus four PowerXCell 8i™ processors used as computational accelerators. The accelerators used in Roadrunner are a special IBM-developed variant of the Cell processor used in the Sony PlayStation 3®. The node-attached Cell accelerators are what make Roadrunner different than typical clusters.

Roadrunner is still currently the world's fastest with a speed of 1.105 petaflop/s per second, according to the TOP500 announcement at the November 2008 Supercomputing Conference in Austin Texas, and it again retained the #1 position at the June ISC09 conference.